Remarks

In the Office Action dated September 10, 2009, the Examiner rejected claims 1, 9-11, and 19 under 35 U.S.C. § 102 as being anticipated by U.S. Published Patent Application in the name of Thompson 2002/0045920. The Examiner rejected claims 2-5 and 12-15 under 35 U.S.C. § 103 as being unpatentable over Thompson in view of U.S. Published Patent Application in the name of Tajima 2001/0002924. The Examiner rejected claims 6 and 16 under 35 U.S.C. § 103 as being unpatentable over Thompson in view of U.S. Published Patent Application in the name of Katayama et al. 2001/0021234. The Examiner rejected claims 7, 8, 17, 18, and 20 under 35 U.S.C. § 103 as being unpatentable over Thompson in view of U.S. Patent in the name of Young 4,066,841.

Initially, independent claim 1 now requires a fully digital FSK demodulator for demodulating an FSK signal having a data rate from a carrier signal having a pair of carrier frequencies. Not only is the demodulator fully digital, but also a data transfer protocol is fully digital to make the system robust.

Independent claim 11 also now requires a fully digital FSK demodulator for demodulating an FSK signal having a data rate from a carrier signal having a pair of carrier frequencies. The demodulator is fully digital to minimize the amount of surface area occupied by the demodulator on the claimed substrate.

Independent claim 20 is a method for demodulating an FSK signal having a data rate from a carrier signal having a pair of carrier frequencies wherein the method includes digitally measuring the period of each received positive half cycle of the FSK carrier signal, digitally generating a serial data bit stream based on the FSK carrier signal and digitally generating a synchronized constant frequency clock signal based on a digital data transfer protocol.

The main focus of Thompson is indicated in his title and his Summary of the Invention (i.e., the use of integrated "thin film bulk acoustic resonator (FBAR) filters" to

demodulate telemetry signals sent to an implanted medical device such as a pacemaker). The architecture of his demodulator is shown in Fig. 4. This demodulator is a standard analog RF FSK demodulator based on down conversion of an incoming RF signal by mixing it with a local oscillator (LO), and generating I and Q components, followed by filtering and digital signal processing (DSP). This circuit is not a digital FSK demodulator. The only digital component illustrated in Figure 4 is the DSP block 420, which operates only after the baseband data recovery has been accomplished. This is similar to any other standard analog RF FSK demodulator.

The method of Thompson is well known, but has several disadvantages in the area of implantable devices, the most important of which are its complexity and its need for multiple filters. For example, Fig. 4 of Thompson shows five filters in his RF FSK demodulator. These filters significantly increase the size of the proposed circuit in this low frequency end RF signals (1 ~ 25 MHZ), where off-chip components used for the construction of filters, such as inductors (L) and capacitors (C) are quite large and bulky. This is the reason why Thompson uses thin film bulk acoustic resonator (FBAR) filters. A problem of implementing the FBAR filters on a chip is that such implementation requires specialized processes, which are very expensive. It is doubtful that this can be implemented using standard, low cost CMOS processes. Another problem is that the integrated FBARs cannot provide the same quality factors as off-chip SAW filters. Finally, the complexity of the analog RF FSK demodulator of Thompson results in significantly increased power consumption (in the mixer and other blocks), which cannot be addressed even by integrating the numerous filters on the chip.

Unlike Thompson, the claimed FSK demodulator is entirely digital and there is not a single analog RF filtering component used in the circuit. One embodiment of the claimed invention is illustrated in Figure 5.

In paragraph [0018] of Thompson, Thompson is merely describing the basics of FSK data transmission. This paragraph does not mean that Thompson's FSK demodulator circuit, shown in Fig. 4 of his application, is a digital FSK demodulator. Contrary to the Examiner's assertion, Thompson's standard analog RF FSK demodulator is NOT a digital FSK demodulator. Only the presently claimed invention provides a digital FSK demodulator.

The data transmission system described by Tajima is a "capacitively" coupled system that is meant for portable/wearable electronics, such as listening to mp3 players. Tajima does not propose any particular FSK demodulation circuit. Moreover, the Examiner points out to Fig. 3 in Tajima's application, in which f1 = 11 MHZ and f2 = 2.3 MHZ are used for a full-duplex communication at a data rate of more than 1 MHZ. The Examiner concludes that one of these frequencies is approximately twice the other. However, it is clear that f1 = 11 MHZ is NOT twice f2 = 2.3 MHZ. In fact, in paragraph [0031], Tajima mentions that f1/f2 = 11/2.3 ≈ 5.

The RF FSK receiver and demodulator presented by Katayama, as shown in Fig. 2 of his application, is very similar to that shown in Figure 4 of Thompson. This architecture is very close to a standard analog RF FSK demodulator based on down conversion of an incoming RF signal by mixing it with a local oscillator (LO), and generating I and Q components, followed by filtering and digital signal processing (DSP). The only difference here is the use of filters with an adjustable cut-off frequency. Again, such features are well known, but again have several disadvantages, the most important of which are their complexity, the need for multiple filters, large area, and high power consumption. The type of error that Katayama discloses is a "frequency error" between the incoming carrier frequency and that of the local oscillator (LO). This "frequency error" is measured and fed back into LO to adjust its frequency.

There are several differences between the claimed demodulation method of the present invention and the FSK modulation/demodulation method proposed by Young. Even though both methods are considered phase-coherent FSK (pcFSK) modulation, which means the frequency changes only occur at zero-crossings, Young assigns "half cycles" of each of the two different frequencies, i.e. to marks (1s) and spaces (0s). Young does not specify the relationship between these two frequencies, and does not say anything about how they are being selected. Therefore, one can only assume that these two frequencies (f1 and f0) are completely uncorrelated. Therefore, the duration of each bit in Young's method depends on its value (0 or 1), and considering the random nature of the incoming serial data bit stream, deriving a constant clock signal that is synchronized with the received data bit stream or a constant data rate out of the pcFSK modulation technique, which is proposed by Young, is high improbable, whether it is used alone or in combination with the analog RF FSK demodulator proposed by Thompson.

As the title of Young's patent suggests, most of the circuits and solutions that are presented in his patent are for generation, modulation, and transmission of an FSK signal, not for receiving or demodulating it. It is obvious from Fig. 8 of Young's patent that neither his detected serial data bit stream nor the clock have a constant frequency. Young's invention is meant to be used for very low frequency systems (300 Hz to 3500 Hz) with low data rates over telephone lines.

Claim 5 of the present application, clearly indicates that one of the two pcFSK frequencies (f0) that is assigned to 0s is twice the frequency (f1), which is assigned to 1s. As shown in Fig. 2a of the present application, at least one "full cycle" of the carrier signal at f1 is assigned to a "bit 1", and two "full cycles" of the carrier signal at f0 are assigned to a "bit 0". The result is that the duration of each data bit substantially remains constant, independent of its value. Consequently, a constant clock is generated that is synchronized with the received data bit stream and a constant data rate is maintained from the received pcFSK signal. This mechanism adds to the robustness of the digital FSK demodulator of at lease one embodiment of the present invention, and has a clear advantage over Young.

Consequently, in view of the above and in the absence of better art, Applicants' attorney respectfully submits the application is in condition for allowance which allowance is respectfully requested.

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Respectfully submitted,

Maysam Ghovanloo

By /David R. Syrowik/
David R. Syrowik
Reg. No. 27,956
Attorney/Agent for Applicant

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BROOKS KUSHMAN P.C.
1000 Town Center, 22nd Floor
Southfield, MI 48075-1238
Phone: 248-358-4400
Fax: 248-358-3351